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Atmospheric Infrared Sounder

Characterization and Validation of Cloud-Cleared Radiances

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Methodologies

- Develop independent test for cloud contamination
  - *Results of tests empirically derived from clear scene radiances*
- Assess quality based on impact on retrieved products
- Characterize and compare statistical variability
  - *Mean*
  - *Standard deviation*
  - *Covariance (EOF's)*

Clear Sky Test of CC Radiances

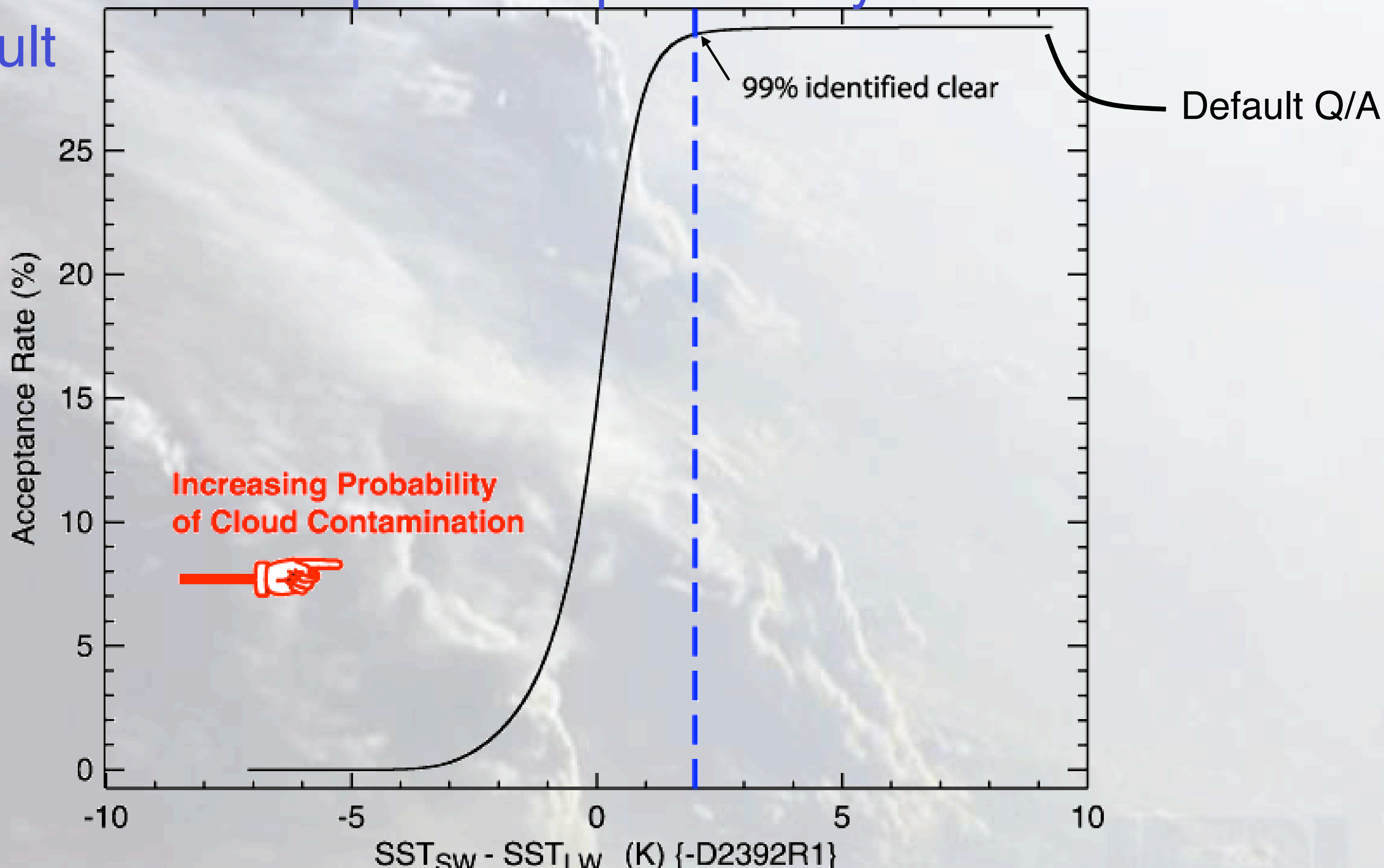
- CC radiances should pass a clear scene test
- Clear scene discriminants were derived empirically
  Discriminants increase with increasing cloud contamination
  - *Perturbation to outgoing thermal IR*
- More than 8 discriminants have been derived
- Validated
  - *Intercomparisons with correlative SST and*
  - *Review of observed – calculated spectra*
- Accurate to 0.1-0.3K

Clear Sky Discriminants

- Approaches (empirical)
  - *Comparison of SST in difference spectral windows*
  - *Extrapolation of lapse rate to surface (4.5mm)*
  - *Split-window approach (9 -12 mm)*
  - *Window channel with reflected-solar correction (SW)*
  - *Neighboring footprint coherency (LW & SW)*
  - *Tropical lapse rate (SW)*
  - *Cirrus signal detection (LW)*

Acceptance Rate

- All discriminants produce qualitatively the same result



- Does not address amount of cloud contamination

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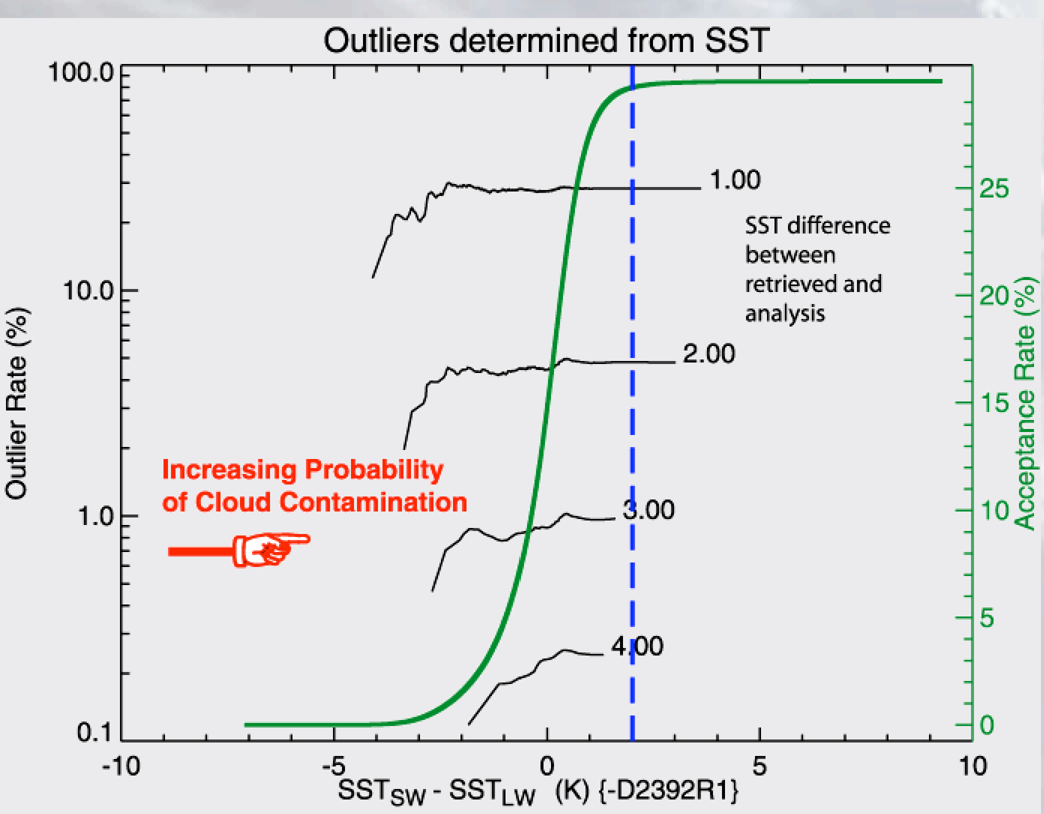
Quality Assessment Based on Geophysical Intercomparison

- Indirect validation
  - *no direct estimate of amount of contamination*
- Geophysical products are retrieved from CC radiances
- Radiance noise from cloud contamination is correlated
  - *No error cancellation*
  - *1-to-1 correspondence between radiance bias and retrieved temperature*
- Correlative data sources
  - *SST from NCEP analysis*
  - *Mean tropospheric temperature (Sfc – 700 hPa)*

SST-based Assessment



Conclusions

- Outlier rate uncorrelated with clear assessment
- SST error density function independent of discriminant
- Many AIRS retrieved SST differ from analysis by more than 1K
- Retrieved product quality not a strong validation source

AIRS is skin, analysis is bulk

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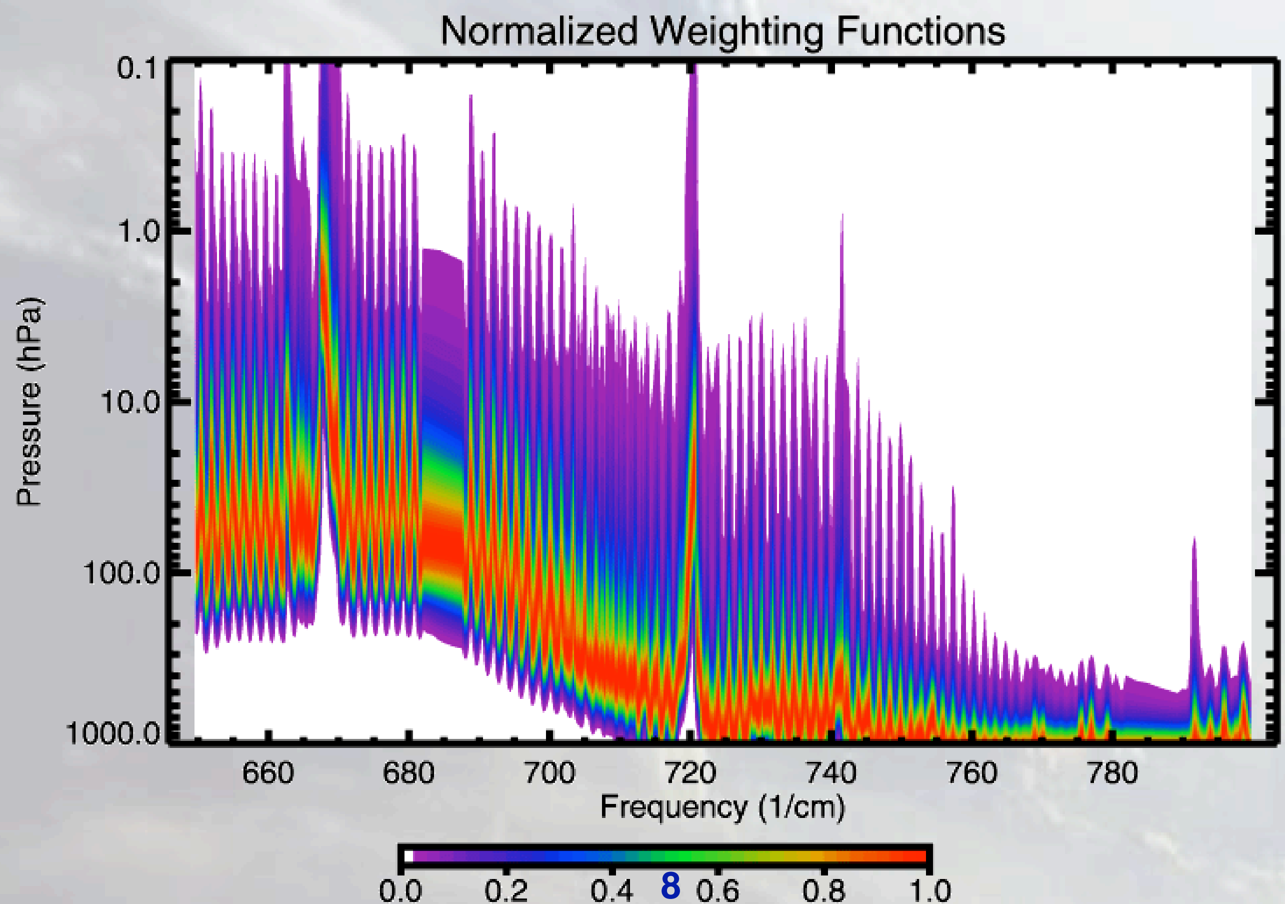
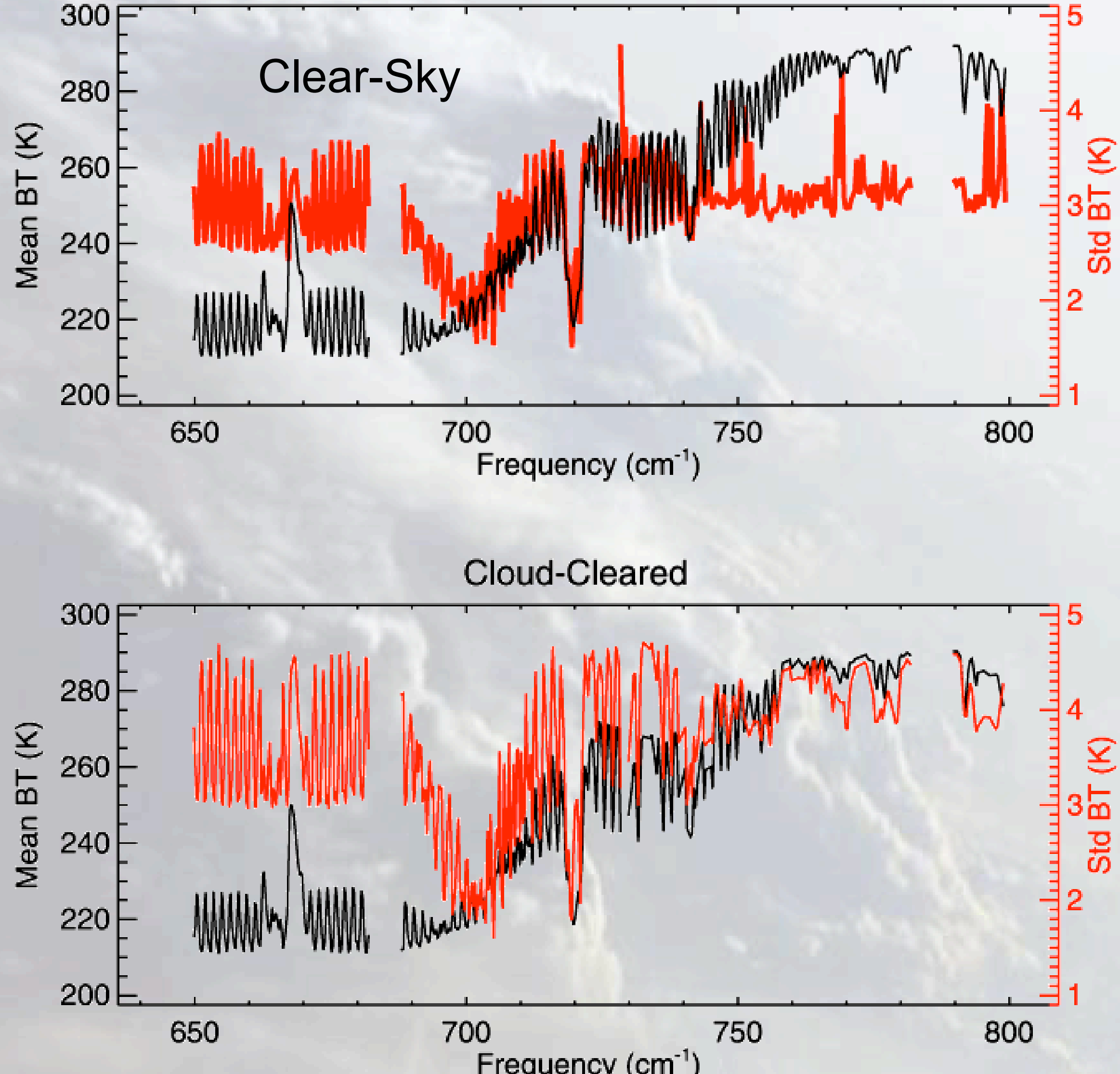
Empirical Orthogonal Functions Data

- Train on 826,340 identified clear spectra (11 Focus Days)
- LW temperature sounding channels (470)



Clear and CC Statistics Mean and Standard Deviation



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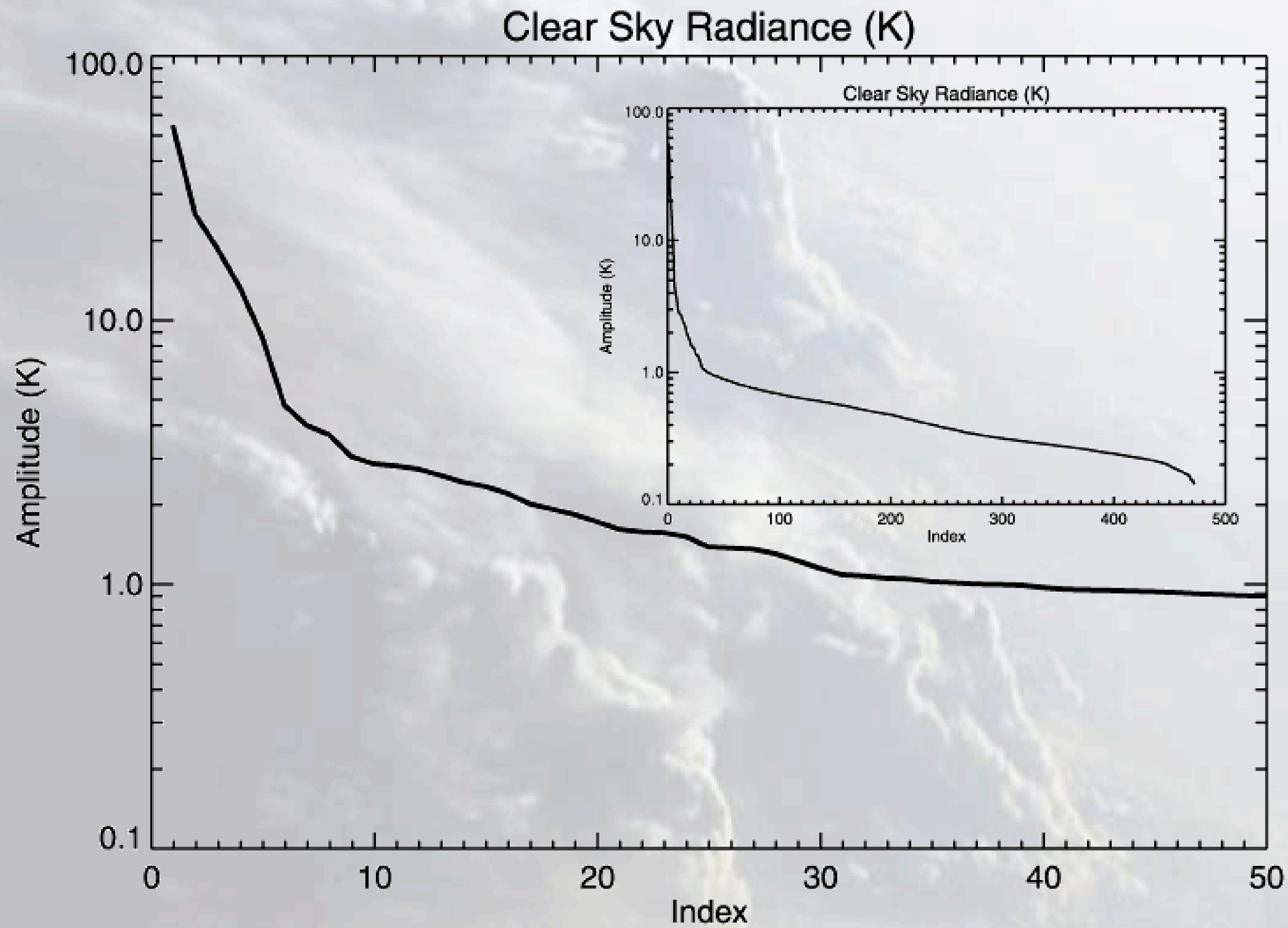
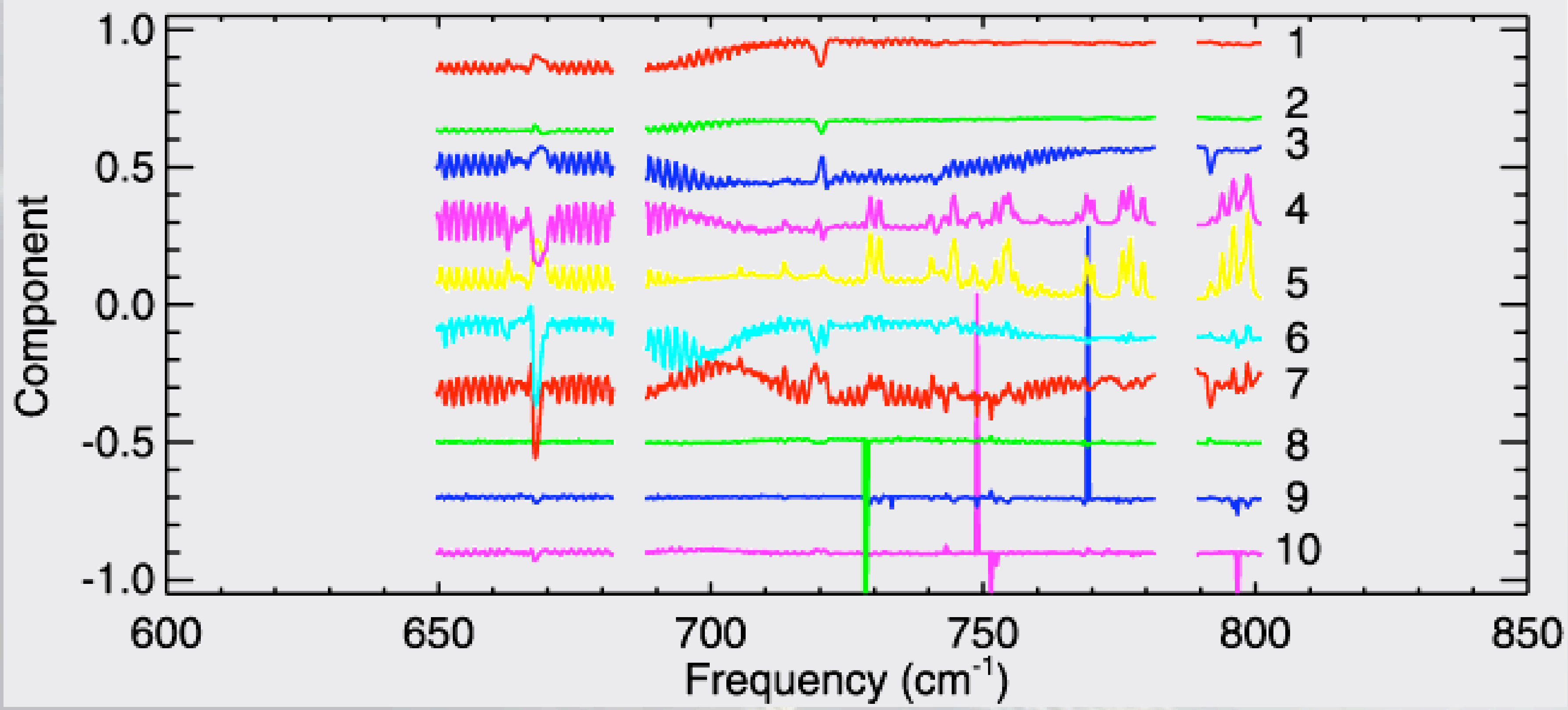
Clear Sky Eigenvalues



Clear Sky Eigenvectors



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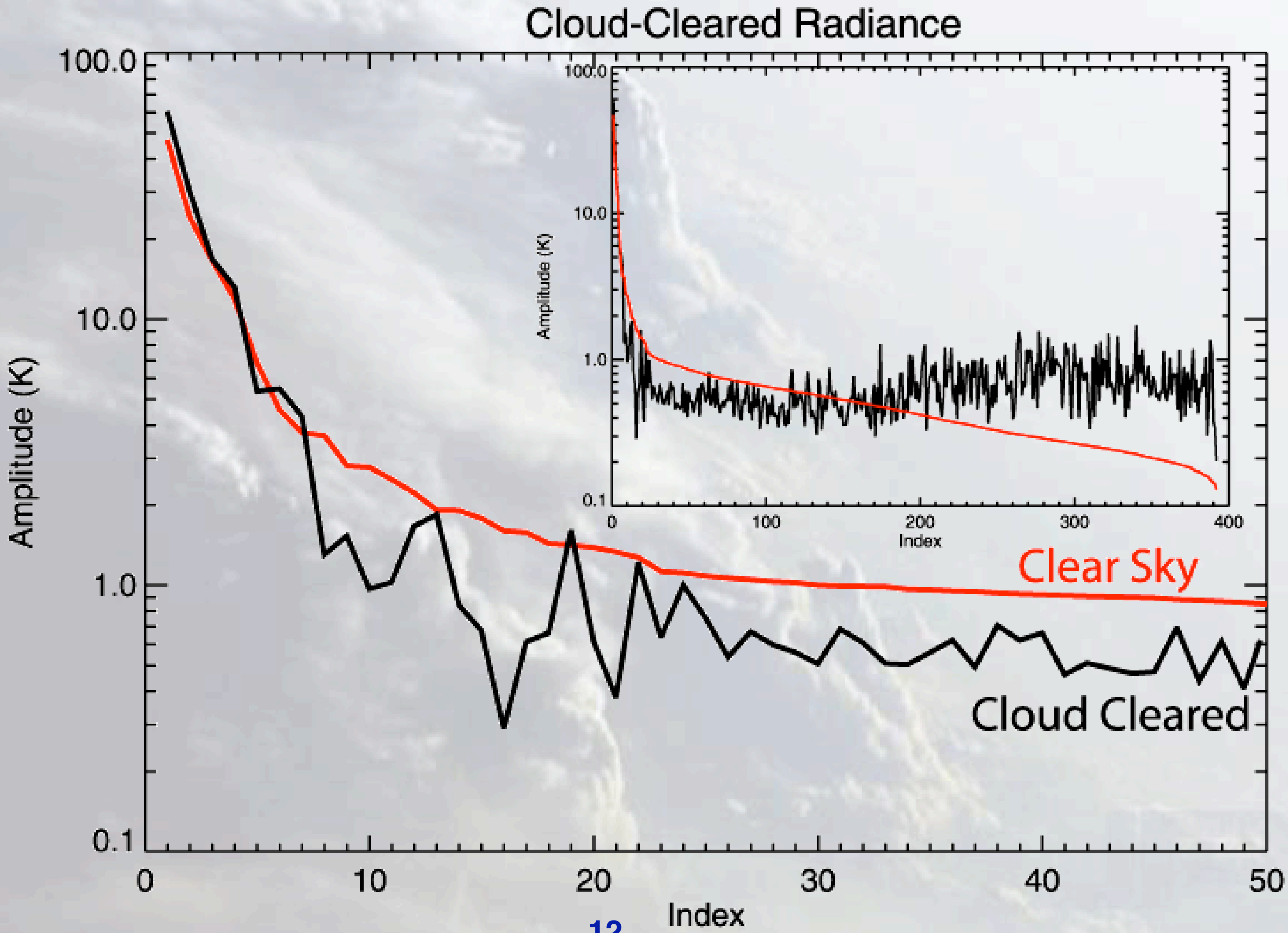
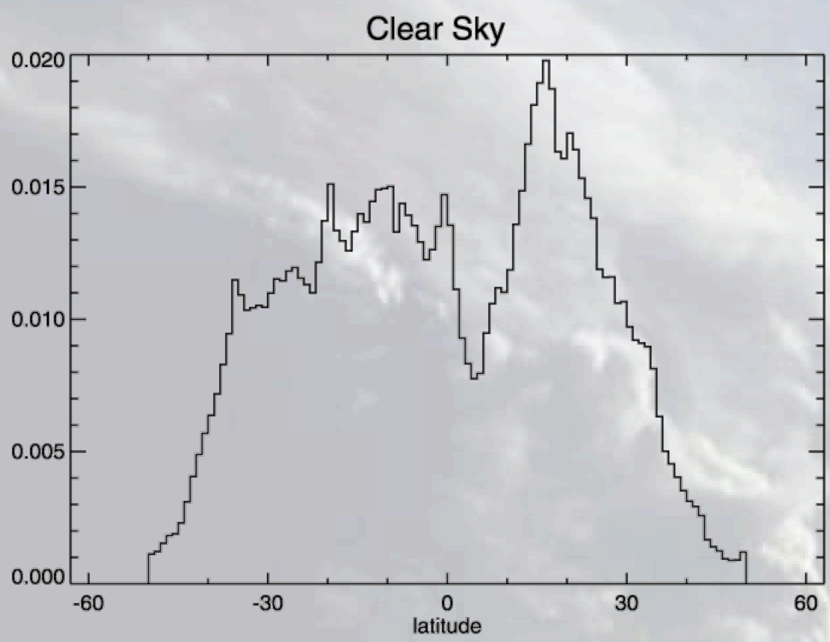
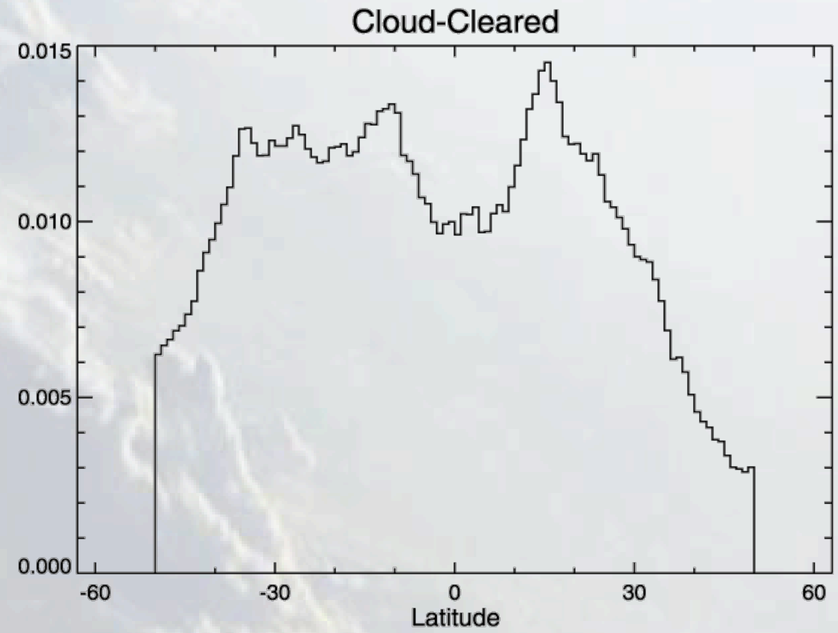
Cloud-Cleared Eigenvalues



Latitude Sampling





Conclusions

- Application of cloud-contamination test
  - *Most of CC radiances past test*
- Assessment of quality based on impact on retrieved products
  - *Outlier rate not dependent on clear test*
    - Suggests outliers do not arise from errors in CC radiances
- Characterize and compare statistical variability
  - *Small differences in most significant eigenvectors*
    - Larger sample of states
  - *Larger eigenvalues at least significant*
    - Evidence of noise amplification

Conclusions

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Supplemental Slides

Clear Scene Prescription

Name	Description	Location	Time of Day	Default Condition
SST1231r5	SST from LW channels using a split window	Ocean	Day/Night	
SST2392r1	SST from SW channels using lapse rate extrapolation	Ocen	Day/Night	
d2392r1	Difference of SST from LW and SW channels, SST1231r5-SST2392r1	Ocean	Day/Night	> -2K
dd12g5	SST LW/SW difference with glint correction	Ocean	Day	abs < 0.5K
d12	SST LW/SW difference w/o glint correction	Ocean	Night	abs < 0.25K
d23	LW Thin cirrus and silicate dust predictor	Ocean	Day/Night	abs < 0.25K
d34	LW Thin cirrus predictor	Ocean	Day/Night	abs < 0.5K
lrt	SW lapse rate	Tropical Ocean	Day/Night	> 3.5K
g5n	SW sun glint detector	Ocean	Day	< 3
spatial_coh 11 um	Std Deviation in LW predicted SST	Everywhere	Day/Night	< 0.5

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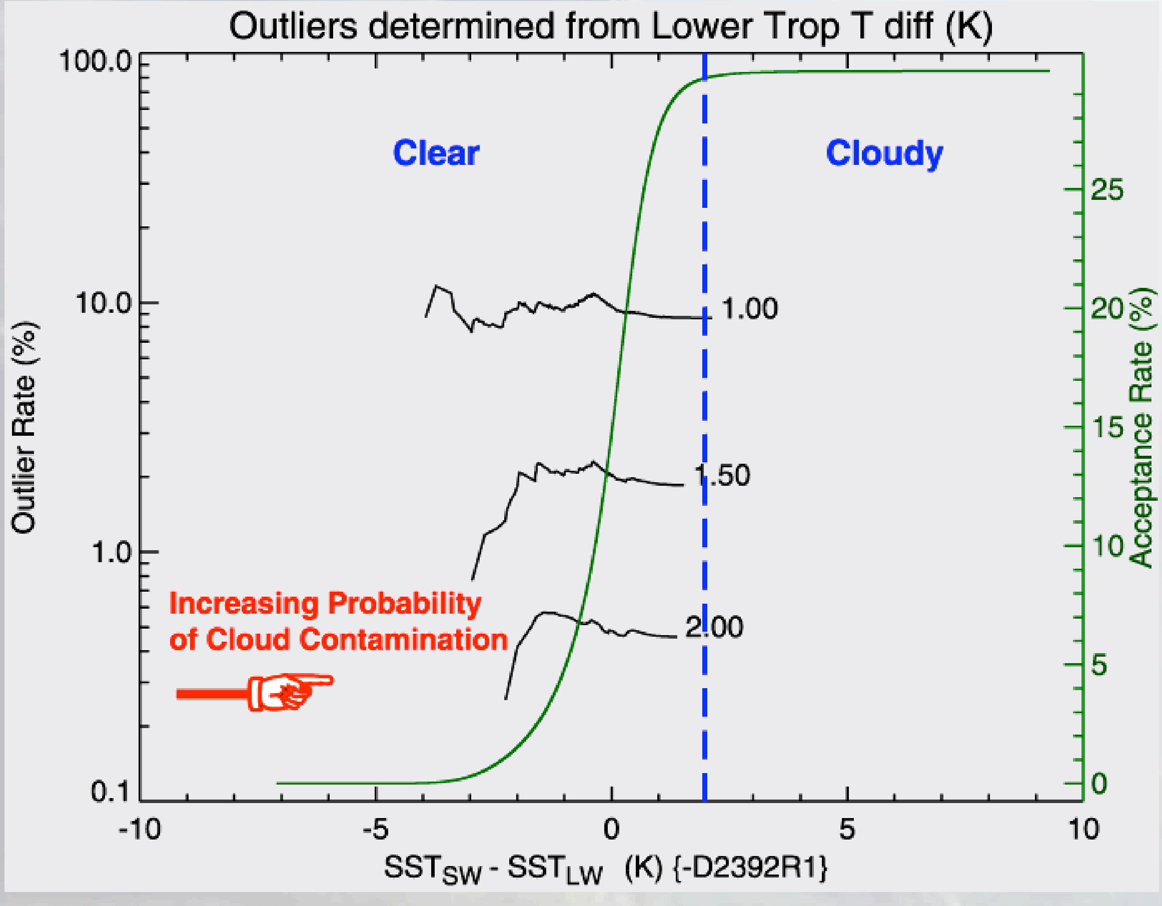
Lower Tropospheric Temperature Assessment



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Discriminant Examples